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The Adoption of Open Sources within Higher Education
In Europe and A Dissemination Case Study

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ABSTRACT

For some time now, the open-source (OS) phenomenon has been making its presence felt; disrupting the economics of the software industry and, by proxy, the business of education. A combination of the financial pressure Higher Education Institutions (HEIs) find themselves under and the increasing focus on the use of technology to enhance students' learning have encouraged many HEIs to look towards alternative approaches to teaching and learning. Meanwhile, the "OS" has challenged assumptions about how intellectual products are created and protected and has greatly increased the quantity and arguably the quality of educational technologies available to HEIs.

Hence, the article outlines the development and proliferation of OS Software (OSS) within the sphere of education. It discusses the reasons for the acceptance and spread of OSS in HEIs across Europe, outlining its role within the four key domains of higher education. Finally, the article illustrates the case of a current Tempus Project in Central Asia, for which OS-based virtual learning environments (VLEs) have provided support for the delivery of a convergent curriculum across several HEIs in Central Asia.

Key words: Open-source, Higher Education, Virtual Environments

INTRODUCTION

The opportunities that open-source software (OSS) or Free OSS (FOSS)i has created for information and communication technologies (ICTs) are becoming widely recognised. The OSS trend has threatened to undermine the profits of a large section of the ICT industry. The amount of information available on the Internet is increasing at an exponential rate. At the same time networking, once the preserve of the military and later of scientists and technicians, has become the chosen means of interaction for a loose community of programmers. The Internet is no longer simply a library of information; it is also a vast forum for expression, a place where the philosophy of inclusion has created a space for itself.

The increase in interest in OSS is quite clearly linked to the inception and widespread adoption of the Internet as a virtual meeting placed. The

ubiquitous communication infrastructure that the Internet provides inherently supports globally distributed product development. Consequently, the Internet was recognized at an early stage to be an enabling factor that allows companies to meet the challenges of developing software under tightening market conditions (Maurer and Kaiser, 1998; Maurer and Bellen, 1998). According to recent figures, the Internet is becoming increasingly dominated by OSS (see Wheeler, 2004). Leaving source code open has generated some of the most sophisticated developments in computer technology including, most notably, Linux and Apache, which pose a significant challenge to Microsoft within the software marketplace. As Weber (2004) observes, open source's success in a highly competitive industry has threatened many assumptions about how businesses are run, and how intellectual products are created and protected.

Traditionally, intellectual property law has allowed companies to control knowledge and has guarded the rights of the innovator, at the expense of industry-wide cooperation; in turn, engineers of software codification are rewarded financially. However, despite the conventional wisdom that innovation is driven by the promise of individual and corporate wealth, ensuring the free distribution of code among programmers can empower a more effective process for building intellectual products. OSS simply inverts the logic of the proprietary principle. In the case of OSS, independent programmers, sometimes hundreds or thousands of them, make unpaid contributions to software that develops organically, through trial and error. Much of the innovative programming that powers the Internet, creates operating systems, and produces software is the result of OS coding, that is, a code that is freely distributed - as opposed to being kept confidential - by those who write it. Moreover, beyond this simple innovation in programming, Weber (2004) argues that the success of OSS lies beyond economic motivation and reward. The OS community is guided by standards, rules, decision making procedures and sanctioning mechanisms. OSS thus has inexorable effects on the political and economic dynamics of ICT-driven markets and therefore on education.

The paper outlines the development and proliferation of open-source software within the sphere of teaching and learning. It discusses the reasons for the acceptance and spread of open-source software in HEIs across Europe, and outlines the role of OSS within the four key domains of higher education. Finally, the article discusses the case of a current Tempus Project in Central Asia, for which OS-based Virtual Learning Environments (VLEs) have provided support for the delivery of a convergent curriculum across several Higher Education Institutions (HEIs) in Central Asia.

THE OPEN SOURCE PHENOMENON

OS as a phenomenon is not only a matter of interactions between humans and technology and of change in organizations. OS technology has also had a direct impact on economic values, and not only, by virtue of its capacity for creating new opportunities. If, on the one hand, OSS has affected the social organization of software production by expanding the realms of

possibility, on the other it has offered individuals and institutions new options to choose from. From a social constructive perspective, the potential for external benefits from a new technology will often not be realized by the individual developer and will rather accrue to society as a result of a deliberate social action (Mesthene, [1969] 1995).

Although Linux is perhaps the most visible outcome of a new software programming revolution and is perceived as an alternative to Microsoft in High Places (Lohr, 2002), its origins can be traced back to 1969, when Unix was introduced by AT&T Laboratories. Unix subsequently became the operating system of choice for Internet technologies, more or less free for use within universities and research environments. Within the Unix environment, the sharing of source code among software developers became commonplace. However, a change in direction came at the beginning of the 1980's when AT&T changed its licensing conditions and started charging a fee for the use of Unix. As a result, other computer manufacturers started to develop their own proprietary Unix-based operating systems. In 1991, a computer graduate student in Helsinki named Linus Torvalds released the source code of a new operating system called Minix, crucially permitting other programmers to modify, improve and distribute it on a free basis.

At this point it is worth noting the misleading nature the term 'free' within the context of OSS. A distinction must be made between 'zero price' and the concept of 'freedom' as observed by Richard Stallman, founder of the Free Software Foundation (FSF) and initiator of a project called GNUii. All software developed within this project is guaranteed to be free and available for anyone to use. Free software is understood, within this context, as relating to users' freedom to run, copy, distribute, study, change and improve software. In practical terms, a program is considered to be free software if users are able to indiscriminately redistribute copies, either with or without modifications, gratis or possibly charging a fee for distribution. Thus, 'free' in the sense of having permission, as applied by the FSF should not be confounded with the notion of costless or zero price. Furthermore, although the above philosophy explicitly grants a number of freedoms to the user, free software should not be confused with programs such as Freeware, Shareware or Adware, to cite but a few, all of which are proprietary software available at no costiii. Figure 1 below illustrates the relationship between the various different types of software.

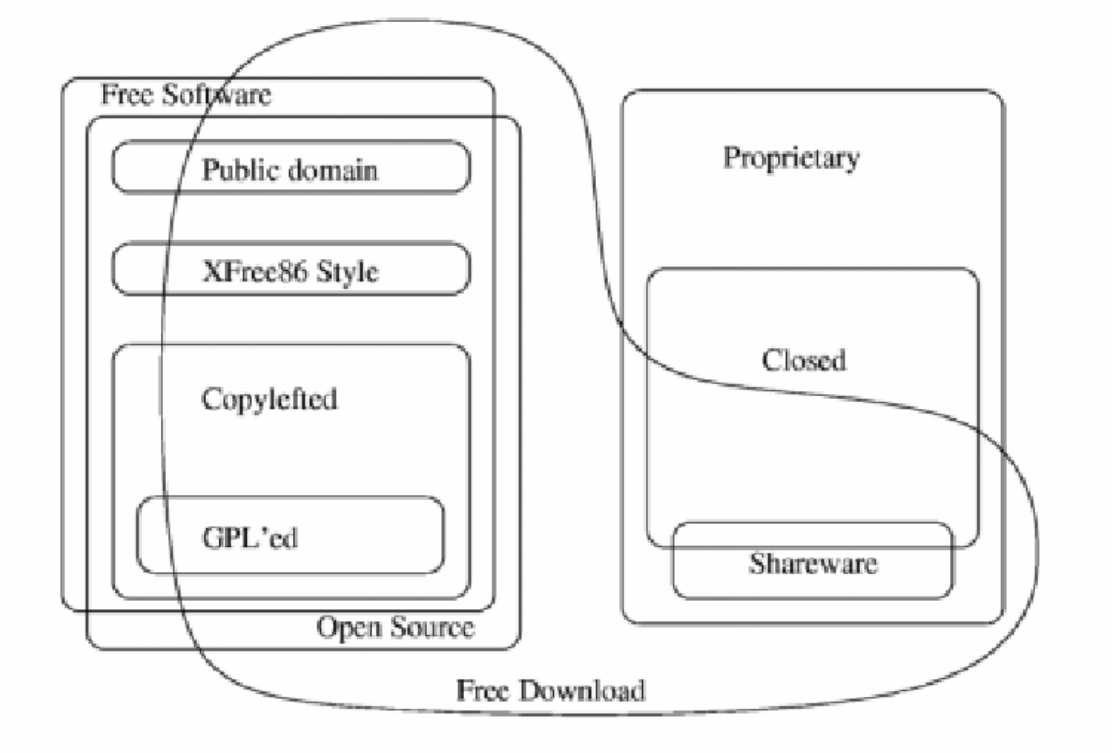

Figure 1 - Types of Relations between software
Source: Statskontoren, 2003.

Against the political and social philosophy of the FSF, the birth of the Open-Source Initiative (OSI) in 1997 brought about practical and technical improvements to software developmentiv. A set of guidelines, known as the Debian Free Software Guidelines, which laid down the basis and principles of OS code, were established by OSI co-founders Bruce Perens and Eric S. Raymond. The fundamental idea of OSS is very simple. When programmers can read, redistribute, and modify the source code for a piece of software, the software evolves. Programmers improve it, adapt it and fix bugs, and this can happen at a very fast pace. As Raymond (1999) described: "*given enough eyeballs all bugs are shallow*".

It can be argued that the great breakthrough in OSS has been to take the concept into the commercial marketplace. The Linux computer operating system is perhaps the best known development of OSS, but it is merely the tip of the OS iceberg. The impacts of OSS are being felt much more widely. Middleware, the systems software that bridges the gap between modern communications-enabled operating systems and state-of-the-art applications and has become central in an era when many applications run over the Internet, is already feeling the winds of the change. Bringing this alternative to the marketplace arguably challenges the existence of all those proprietary operating systems which are not free to use and definitely not free to distribute or pass around. However, as Bessen (2004) suggests, it is better to view FL\OSS as a complement to proprietary provision, recognizing that proprietary provision fails to effectively meet the needs of many customers in markets where customers have highly

disparate needs and products are complex. Where there is a large market, especially a large technically-unsophisticated market, it will always be more profitable to sell a product rather than give it away. Thus, Green (2002) argues, it is not inevitable that OSS will replace commercial software.

Within the private sector, companies large and small are embracing Linux and OSS for a variety of reasons, including cost, reliability, flexibility, and availability. Indeed, it has been argued that FLOSS development follows an adaptive lifecycle, with a flexible management model emphasizing leadership, collaboration, and accountability (Johnson, 2001). However, in the commercial sphere, the process of adapting to Linux and OSS has proved disruptive, since basic tenets about the value and secrecy of source code are being threatened. Conversely, in the education sector, HEIs have been using Unix and encouraging the sharing of ideas and source code for some time. Indeed as observed by Kegel (2002), the collaborative methods used to develop Linux and many OSS projects are fascinating the world in their own right.

PROLIFERATION OF OSS IN HEIS

As discussed above, the acceptance and spread of OSS in HEIs began as early as the 1960s as a result of the Unix movement in the 1960s. One of the benefits attributed to OSS is that it can help, enhance, and complement education by providing tools to promote teaching and learning activities. Hence, the number of universities and colleges that are migrating towards Linux and OSS is on the rise. Sometimes the shift is fostered by public initiatives (e.g. the Linux for Schools Project in Norway or Linex in Spain). In other cases, financial reasons underlie a switch to OSS. De Praetere (2002) proposes a four dimensional model for reasoning the proliferation of OSS. Correspondingly, a fourfold framework is applied below to explain the flourishing of OSS in HEIs.

Economic reasons are an important motivation for HEIs when moving from proprietary to open-source environments. The drive to increase the use of technology to enhance students' learning within the constraints of limited budgets has encouraged many HEIs to look towards alternative approaches to teaching and learning. The purchase and maintenance of computer-based learning technologies tends to drive up costs and gains in the quality and the richness of the educational environment must be offset against these costs. In this respect, OS environments bring opportunities to reduce costs whilst nevertheless increasing the use of educational technologies in several ways.

Firstly, HEIs can save on the costs of developing a customised VLE irrespective of student numbers. Traditionally, HEIs have needed a large number of students to break even when developing their own VLE. Reusable learning objects and digital repositories available for use with VLEs make it possible to achieve economies of scale in online course development. There are many examples of groups of institutions in Europe which pool their resources to develop materials that any members of the teaching community can use. Initiatives such as the Trans-European

Research and Education Networking Association (TERENA) demonstrate the potential benefits of inter- and intra-institutional cooperation through open sources in order to "... *promote and participate in the development of a high quality international information and telecommunications infrastructure for the benefit of research and education*" (TERENA, 1994:1).

A further argument in favour of the use of OSS is the possibility of achieving greater independence as far as price and licensing conditions are concerned whilst simultaneously driving down licensing and copyright costs. Several studies have conducted comparisons of the costs of ICT investment based on proprietary and open-source environments. In cases where there is an environment built on OS, the savings have been estimated to be as high as 35% (Statskantoren, 2003). The differences in cost can primarily be attributed to lower licensing costs for software applications in an OS environmentv. Other studies on OSS in digital public administration also report the potentially large savings which can be made when changing over to an open-source environment.

It is relatively easy to effect a comparison of the cost of obtaining and upgrading licenses for free, OS and commercial software. However, when other economic factors are taken into consideration, any comparison becomes more complicated. It can be argued that, where an HEI has a functional and stable technological environment, whether based on OS or commercial products, it is generally cheaper to retain that environment. Yet, as soon as changes are made, for example through upgrading an existing software program to a newer version, various costs can arise. Within this context, a change to OS platforms can beneficial as OSS improve freedom of access, reduce technical resource requirements and alleviate training needs through user-friendly interfaces. Thus, although, cost reduction is the biggest driver of the adoption of OS, there are additional costs to be considered above and beyond the actual cost of the software. As Giera (2002:3-4) observes, "*The cost of software is not just the cost of Linux or Windows – there still may need to be investments in systems management and monitoring tools (...) and the cost of maintenance and support...*".

A third factor relates to the development of a market in which HEIs appear as producers and consumers at the same time. For producers, the development of OSS may become less expensive as a result of the contribution of the community of free programmers. Moreover, OSS is arguably enhanced by the existence of external support through this community which may, at the same time, be a useful quality control tool for developers. From the point of view of the consumer, the main concern of the consumer is likely to be interested in low-cost, virtual educational technology solutions that are available in the market. In some cases this may be ordinary, single applets or tools, in others it may be standard software packages, for example communication tools such as whiteboards, which can enhance both course development and teaching and learning techniques.

A final economic aspect considered here is the question of generic products offered by OSS. In the case of HEIs, standardized educational software packages often fail to meet specific content-related needs. Therefore, HEIs may either decide to develop their own products or to purchase some tool that is already developed and on the market. Likewise, OSS and proprietary software may exist side by side in a given HEI, serving different groups of needs.

Other aspects to take into consideration when analysing the success of OSS in HEIs include non-economic parameters. These can be categorised as technological, pedagogical and philosophic.

Technological

OSS must compete with other proprietary software in terms of viability, stability, robustness, speed, service. The technical quality is a determining aspect when opting for OSS. Many HEIs create Learning Content Management Systems, Learning Management Environments and/or VLEs with the same characteristics and operating capacities as well known proprietary software. HEI managers are likely to be concerned with quality and accessibility, as well as with cost and effectiveness. In cases where there is little to differentiate between the technological capabilities of the software, initial considerations are likely to be about the opportunity cost offer by an OS design which provides the same tools as proprietary platforms.

Is also worth noting that some OS projects have well defined and organised management structure?. The contributors may come from the academic or student body, but can also be private persons, associations or commercial corporations. Whether the development is centralized at local level or is devolved to a wider group, the key is to manage it properly, avoiding unnecessary modifications and mediocre input, while extracting the maximum benefit from all valuable contributions. The open and modular structure of OSS allows the vertical integration of discretionary modules to a common platform with standard documentation and the interface is designed to allow numerous developments such as the free treatment of images based on the Gnu Image Management Programme (GIMP) or other such applications.

Open architecture also means that OSS licenses specify that they must be technology-neutral: in other words, no provision of the license may be reliant on any individual technology or style of interface and the license must not restrict other software that is distributed alongside. For example, the license should not prescribe that all other programs distributed on the same medium must be OSS. It is essential that OSS licenses both facilitate and encourage product development within the IT market, whilst avoiding any deterrents to voluntary contributors and recognizing their contributions on some level. Other technological factors (critical for the success of OSS), are cited in Lang (1997). These are directly linked to measures of popularity, good maintenance, evolution and ease of use (e.g. installation, documentation, etc.).

A recent study has identified the interoperability of open standards to be a further technological issue of specific interest to HEIs (see Tannenbaum,

2004). The most popular reason HEI respondents gave for choosing OSS packages over proprietary software was interoperability. Interoperability and open standards are fundamental prerequisites for a holistic and integrated IT environment which ensure the reusability of many of the objects that are free copyrighted. If the educational platform is designed around generic re-usable software, such as digital repositories or data ware houses for reusable multimedia learning materials storing various types of courseware or documents, the time and cost of building a virtual course can be considerably reduced.

Pedagogical

Academic interest in developing technologies and new ways of working is better aligned with the use of OS than large, proprietary products. Coen (2004) argues that the reason behind this is the academic ethos and the paucity of commercial products to service some aspects of academic activity. The web does not necessarily have to be used as an alternative to traditional face to face teaching methods. ADEC (2002), WICHE (1996) and other organisations seek to establish principles intended to serve as pedagogic guidelines for identifying and evaluating web-based courses and non-formal educational programs that can be applied to Virtual Learning Environments Based on Open Sources (VLEBOS). VLEBOS may be designed for distance learning as well as face to face teaching serving, within the latter environment, to reduce teaching loads and provide a greater level of autonomy for students in the learning process. However, as some authors fear, there is an automated dimension inherent in educational technologies that may alienate the human factor in teaching and learning.

Nevertheless, learning experiences should support interaction, networking and the development of communities of interest, rather than alienation. OS and the Internet, in this respect, allows teachers and students to explore the world and its learning resources outside the physical boundaries of the University. Unlike proprietary platforms such as WebCT, for example, which work as intranet environments (e.g. no course site can be placed within the public domain and users must identify themselves before entering the system), VLEBOS operate, in the spirit of the Internet, for and with a wide and participative community (students, can self-register for public courses, irrespective of whether or not there are costs involved). As result, teachers and students operating within open environments reap the benefits of input from experts across the globe. It is this facility that the Internet provides to connect distant organisations that attracts the support of many HEIs which envisage the university as a global learning and open communication space.

Moreover, the use of the Internet as a communication tool by VLEBOS revitalises the acquisition of knowledge through a variety of means. Thanks to ICTs, the Internet can be the facilitator of an array of learning scenarios: lectures, self-study, problem-based learning, collaborative learning, learning by experimentation and simulation. VLEBOS oriented towards content, or LCMS, suggest a learning focus on know-how. The development of tools which promote interaction between learners fosters the creation of more collaborative learning and teaching scenarios. Other VLEs may offer several individualized tools for the students. Of course, the

same can be said of proprietary platforms: the difference, however, may lie in how available pedagogic tools are directly or indirectly inspired by learning theories. WebCT contains a strong overriding structure with an impressive battery of test and evaluation tools. Moodle, on the other hand, explicitly presents itself as a social constructive tool and its course management system as a time management tool - a software package designed to help educators create quality online courses. Claroline, for historic reasons, insists on a collaborative approach, but retains architecture of empty and unstructured frames. Within the latter example of a VLE, as De Praetere (2002b) explains, the tool does not appear to guide the teacher in a certain pedagogic direction or towards a certain teaching style. Thus, one of the pedagogic principles at the heart of OS is that of diversification and variety of resources; variety, for example, in the form of course scenarios, disciplines and teaching and learning methods.

The purpose of promoting such a variety of tools is to reconcile the economic objective of profitability in terms of reusing available online resources with the educational objective of fostering motivation and a renewed interest for learning in the student. On the one hand, instructors can benefit from the open and modular structure of open platforms by allowing the vertical integration of digital repositories and re-usable learning objects into their modules as a means of delivering high-quality education and training materials whenever, wherever and in whatever language is needed. On the other hand, learning scenarios which introduce the requirement for interaction between learners may assist in reducing the demand for educational support. However, Dillenbourg & Schneider (1995) argue that existing Internet-based tools which facilitate collaboration often focus on the sending and receiving of messages, whilst neglecting the underlying reasons why users communicate.

Philosophical

Finally, it must be stressed that the choice of OSS is not only a choice of tools, but also a philosophical decision. The philosophy behind using OSS for education means is to develop a collaborative model that also serves to encourage and strength collaboration. Sometimes, as Raymond (2000) concludes, this approach to open-sourcing can be effective not just as a way to expand markets, but also as a strategic manoeuvre against competition. In this respect, it is possible to identify certain level of revolt against Windows (cf. Watchguard Technologies, 1999). It has been suggested that the principle of allowing individuals or corporations to own algorithms is as odious as the idea that an individual or corporation could own a law of physics or a mathematical theorem and that the philosophy of OSS holds much greater benefits for the progress of humanity (Kennington, 2000). A healthy, global information society requires political and legal mechanisms which provide opportunities for both proprietary and non-proprietary developments. The shutting out of one or the other will only aggravate the existing digital divide.

Rajani (2003), expressing his opposition to monopolistic models, regards OSS as a paragon in facilitating the provision of education that is free in terms of access as well as price and reminds the reader that free education is regarded as a fundamental fact of life in many European countries.

Moreover, Lang (1997) argues that economic success can be attributed not only to material resources based on production and the use of tangible goods, but also to immaterial resources based on training and development of knowledge as well as the production, distribution and use of those immaterial resources.

Because "*Information wants to be free*" OS have proposed a cultural, scientific and autonomous model based on interactivity and multilingualism. In the light of the experiences of a number of European HEIs, OSS can be argued to propose easier solutions which are multilingual and are relatively undemanding in terms of infrastructure, hardware and resources, from the point of view of both servers and end clients. As an illustration, the University of Budapest has created a project called Open Access which proposes the distribution of free articles to the scientific community without the necessity of editors or publishers but retaining the scientific quality of the papers through peer review. Because the OS culture comes as a response to an identifiable set of motivations and pressures, OSS strive for cultural, scientific and pedagogic independence in opposition to the post-Fordist educational model prevalent within the USA. It is no coincidence that OSS was developed in Finland, a country with one of the highest rates of social cohesion in Europe. Figure 2 below presents a synopsis of the factors which have contributed to the proliferation of OSS in Higher Education.

Domain	Reasons
Economic	- Eases the burden of software license management. - Open Sources cost less to acquire and run than proprietary software - Independence - Generic Product
Technological	- Reliable and secure technology - Open architecture - Inter-operational - Open but well protected copyrights and licenses
Pedagogical	- Possibility of using different learning scenarios - Web-based learning - Modular and multilingual - Variety of tools
Philosophic	- Collaborative approach - Anti-monopolistic - Free as education - Promotes pan-European vision and social cohesion

Fig. 2 - Four major reasons of the proliferation of Open Sources in Higher Education within the four domains of Education.

PRACTICAL DISSEMINATION CASES OF OPEN SOURCES: VLEBOS IN EUROPE AND CENTRAL ASIA

Although OSS has both historical and philosophical roots in universities, e-learning was not one of the major areas of the open-source software movement during the 1990s and e-learning standards were thus initially developed without a great deal of concern for examples of OSS (Dalzien, 2003:4). Whilst, at the end of the twentieth century, the development of FLOSS was principally focused on basic software infrastructure, such as operating systems and web servers, rather than specific applications such as e-learning, today the reverse can be said to apply. There are numerous examples of virtual campuses throughout Europe and the majority of European universities are now seeking satisfactory ICT solutions which can assist the development of potential virtual campuses. But not every university needs to sponsor its own virtual platform. Some may benefit more from participating as reviewers and occasional contributions (Moore, 2002). E-learning Internet forums facilitate the dissemination of information about software (e.g. technical information, examples of best practice, questions on the functionality of the tools, etc.), ideas and resources. In 2001, the Dokeos platform (http://www.dokeos.com) had been adopted by several hundreds of universities and translated into several languages.

www.dokeos.com (Belgium)
www.claroline.net (France)
www.spaghettilearning.com (Italy)
www.olat.org (Switzerland)
http://physik.uni-graz.at/~cbl/electure (Austria). E-lecture is a free education package the design and presentation of electronic lectures
http://fle3.uiah.fi/index.html (Finland) Developed by the University of Art & Deign of Helsinki. Future Learning Environment (FLE) is a web-based learning environment and a server software for computer supported collaborative learning.
http://learnloop.sourceforge.net (Sweden) It is a groupware aimed for education and collaboration. Developed by Gotheborg University
www.logicampus.com (UK) It is a distance learning and content management system freely available to Universities. It allows to run existing classes or online learning classes via the web as well as providing the institution to create additional integrated applications.
http://openlms.sourceforge.net (Norway) Open source learning Management System (LMS) used by University of Trondheim. It offers a minimum solution for web-based teaching and learning)
http://uni-open-platform.fernuni-hagen.de (Germany) Flexible open source e-learning environment funded by the state of North-Rhine-Westphalia,.
http://www.triana.co.uk/ (Wales). The Triana Project is an open source problem solving environment developed at Cardiff University that combines an intuitive visual interface with powerful data analysis tools.)

Figure 3 - Some Examples of VLEBOS and other educational tools in Europe

Today, more than one thousand organizations use the Dokeos platform throughout forty countries and in more than twenty languages, including all the languages of the EU. However, Dokeos is just one example of VLEBOS which has been successfully adopted by European HEIs. Further examples are provided in Figure 3, all of which contribute to the development of essential components of a 'free' education movement, through associated tools or applications for use in HEIs.

Outside of Europe, the possibilities that OSS offers for developing countries, and indeed minority languages, have recently been attracting increased attention. The example presented here relates to the work of the EU Tempus funded TOHOST-CA project, two principle outcomes of which are the harmonisation of the framework for curriculum development and the setting up of a common, online core curriculum at five Central Asian HEIs in Kyrgyzstan, Mongolia and Uzbekistan. In this way, efforts and progress towards enhancing the curriculum can be shared between the

partner institutions. EU funding has been made available to improve the ICT infrastructure of the five Central Asian HEIs as a preliminary requirement for the efforts towards building an online curriculum. To date, new computer facilities have been provided for academic staff and students. Crucially, links to the Internet have also been upgraded to enable acceptable levels of communication and collaboration between the Central Asian and European partners involved in the project.

In making critical decisions on the choice of e-learning platform to be used for the online curriculum it has been necessary to take a more long term approach to the sustainable future of the online curriculum. The Dokeos platform was ultimately adopted and the rationale for this decision is outlined below within the framework of the four major reasons for the proliferation of OSS in HEIs illustrated in Figure 2 above. The ToHost-CA project is funded for three years. Beyond this period it is likely that the Central Asian HEIs will have to self-fund the online modules. Given the financial difficulties facing the educational sectors within the three developing countries covered by the project, the costly purchase of software licenses and maintenance contracts is not a feasible option. Thus, from an economic perspective the use of an OS model was particularly appropriate for the ToHost-CA project. Meanwhile, the technical advantages of OSS are perhaps less pertinent to developing world countries than they are within Europe. For example, it might be argued that the interoperability of OSS packages is less important to the five Central HEIs, since their existing IT environment is underdeveloped and currently poorly integrated. However, the importance of reusable learning objects and a user-friendly interface should not be underestimated for academic staff within these institutions faced with the enormous task of creating online modules for a curriculum that is relatively new to them.

From a pedagogical perspective, the multilingual advantages of OSS were highly significant. Few, if any, proprietary VLEs are available in the principal languages of the three countries, Uzbek, Kyrgyz and Mongolian. Moreover, the two principal languages of the project, those in which the online teaching materials are most likely to be disseminated, are English and Russian. There was thus a particular need to employ a VLE with enhanced multilingual capabilities. The collaborative approach to providing online education is equally an important philosophical factor in the decision to adopt the Dokeos VLE. As stated above, one of the principal aims of the project is the harmonisation of the framework for curriculum development and indeed the sharing and dissemination of good practice in learning and teaching between all of the European and Central Asian HEIs involved in the project. Moreover, a key underlying motivation for the funding of EU Tempus projects, outlined in the Tacis Strategy document (European Commission, 2001) is the 'reinforcing of ties with neighbouring and partner countries, through an array of new forms of cooperation and assistance'. Whilst a number of questions remain within the project such as how to we cater for the entire range of cultural, social and linguistic diversity of CA users and how to accommodate ICTs to local teaching and learning methods, the collaborative approach adopted and fostered by the Dokeos platform appears to be a very relevant one.

CONCLUDING REMARKS

This paper does not claim to provide a definitive review of all the European initiatives involving OSS. However, it has attempted to illustrate the extent to which the OS model can be a useful and intuitive means of experimenting with different products, sharing ideas and finding technological solutions. Moreover, some of the fundamental reasons for the spread of OSS (and in particular VLEBOS) in HEIs throughout Europe and beyond have been identified and reviewed.

The spirit of open source is formed around diversity of input, recycling of ideas, creativity, and collaboration (Coppola et al, 2004). These are essential ingredients for innovation and present clear advantages for the development of software within the realms of OS philosophy. The philosophical, economic, pedagogic and technological dynamics which underpin the OS model have had a manifest impact on the ways in which information is conceptualised, used and developed. Since the free movement does not rely on concepts like intellectual property or copyright but rather on notions such as voluntary participation and contribution, it may been seen as an ideal tool for bridging the digital divide between developed and developing countries, as illustrated by the case of the ToHost-CA project. Despite its inherent advantages, however, OSS should be regarded not as a universal panacea for the future of e-learning strategies in HEIs, but rather as one of a range of developments that are presently contributing to the democratisation and globalisation of education and will ultimately help shape the virtual universities of tomorrow.

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Footnotes

[1] The term 'free open source software' (FOSS) (free as in freedom, not beer) introduced by Richard Stallman/FSF 1984 focuses on political, ethical and philosophical freedom. The term 'open source' software (OSS) introduced by OSI in 1997 focuses on technological advantage by means of accessing the source code. Although most FOSS licenses match both definitions, OSS is less restrictive than FOSS. For the sake of our argument, OSS is commonly used for both terms.
[1] See the website of the Free Software Foundation at http://www.fsf.org.
[1] A comprehensive review of "The Free Software Definition" can be found at http://www.gnu.org/philosophy/free-sw.html (Retrieved 12 December, 2004)
[1] More information on the OSI can be found at http://www.opensource.org.
[1] As illustration see "Linux vs. Windows – Total Cost of Ownership", a comparison of total costs between systems based on Linux/Open source and MS Windows, by Cybersource Pty. Ltd. 2002.
From http://www.cyber.com.au/cyber/ about/ linux_vs_windows_tco_comparison.pdf

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[ii] **See the website of the Free Software Foundation at http://www.fsf.org.**

[iii] **A comprehensive review of "The Free Software Definition" can be found at http://www.gnu.org/philosophy/free-sw.html (Retrieved 12 December, 2004)**

[iv] **More information on the OSI can be found at http://www.opensource.org.**

[v] **As illustration see "Linux vs. Windows – Total Cost of Ownership", a comparison of total costs between systems based on Linux/Open source and MS Windows, by Cybersource Pty. Ltd. 2002. From http://www.cyber.com.au/cyber/ about/ linux_vs_windows_tco_comparison.pdf**